

KINEMATICS - P1 & P2

(4 - 6 Marks)

you cannot use this formula if speed is changing

DISTANCE

(mm $\xrightarrow{10}$ cm $\xrightarrow{100}$ m $\xrightarrow{1000}$ km)

Forward $\div$

Backward $\times$

SPEED

m/s or ms^{-1}

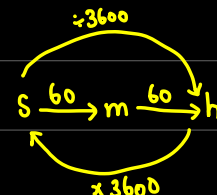
km/h or kmh^{-1}

$$\text{speed} = \frac{\text{Distance}}{\text{time}}$$

SPEED UNIT CONVERSION

1- Convert 72 km/h to m/s.

$$\frac{72 \text{ km} \times 1000}{1 \text{ h} \times 3600} = \frac{72^2 \times 1000}{3600} = 20 \text{ m/s}$$



2- Convert 40 m/s to km/h

$$\frac{40 \text{ m} \div 1000}{1 \text{ s} \div 3600} = \frac{40 \times 3600}{1000} = 144 \text{ km/h}$$

ACCELERATION

Distance	Speed	acc
m	m/s	m/s^2
m	ms^{-1}	ms^{-2}

Rate of change of speed.

$$\text{acceleration} = \frac{\text{final speed}(v) - \text{initial speed}(u)}{\text{time}}$$

$u = 10 \text{ m/s}$



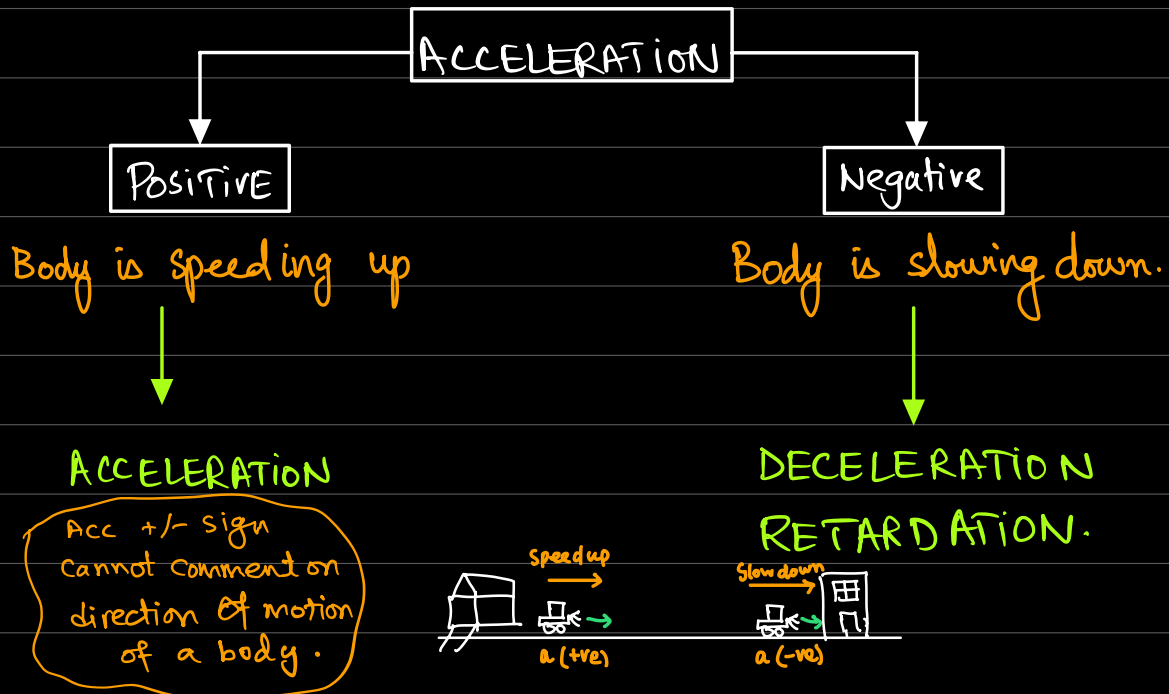
$v = 20 \text{ m/s}$



$t = 5 \text{ sec}$



$$\text{acceleration} = \frac{20 - 10}{5} = 2 \text{ m/s}^2$$

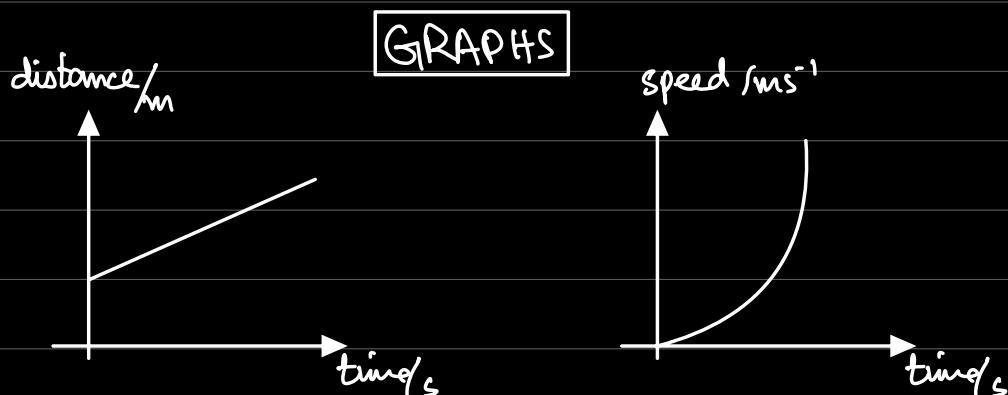


TILL NOW WE STUDIED TWO FORMULAS:

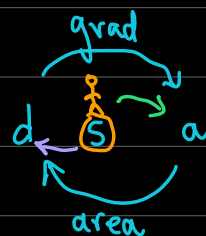
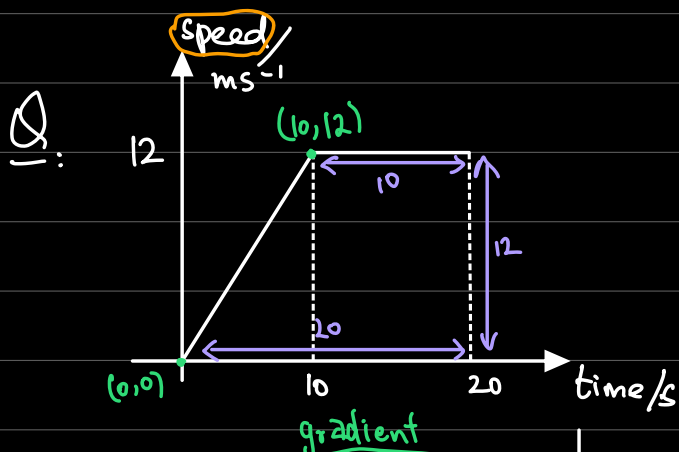
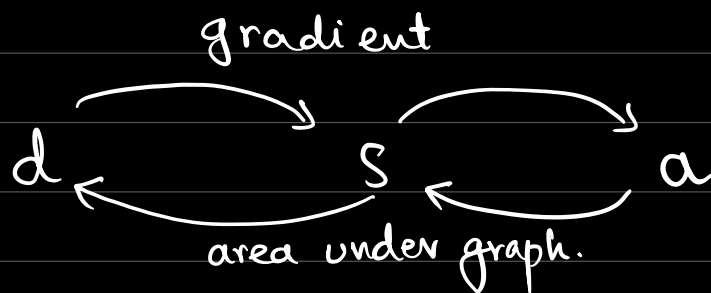
$$\text{speed} = \frac{\text{Distance}}{\text{time}}$$

$$\text{acc} = \frac{v - u}{t}$$

you cannot use these formulas on graphs.



we have a beautiful shortcut for graphs.

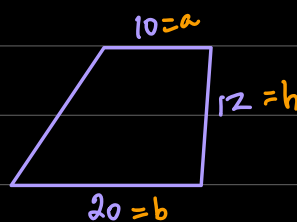


(a) Find acceleration of object in first 10 sec

$$\text{grad} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - 0}{10 - 0} = 1.2$$

$$\text{acc} = 1.2 \text{ m/s}^2$$

(b) Find distance travelled in 20 seconds.

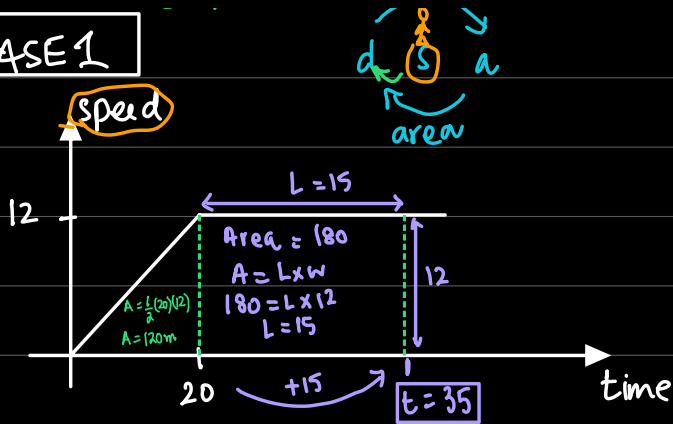


$$\text{Area} = \frac{1}{2} (12)(10 + 20) = 180 \text{ m}$$

Always comes with
↑ speed-time graph

grad

CASE 1



Find the time when object has travelled 300 m.

Distance
(Area under graph)

$$\begin{array}{r} 300 \\ -120 \\ \hline 180 \end{array}$$

$$t = 35$$

Thought process

- 1) Find area of triangle
- 2) Subtract area of triangle from total area to get area of rectangle.
- 3) Use area of rectangle to find the missing length.

$$S = \frac{d}{t}$$

$$d = S \times t$$

$$t = \frac{d}{S}$$

These can only be applied if speed is not changing. (CONSTANT SPEED)

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

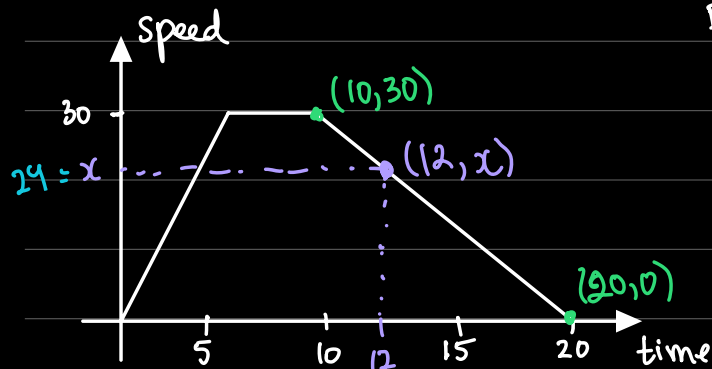
Can be used anywhere.

Case 2

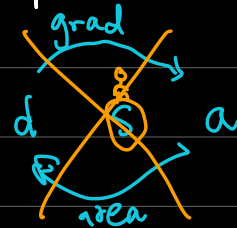
$d/s/a$ will not apply.

Find three points on a line

Find two gradients and put them equal.



Find speed when $t=12$.



$(10, 30)$ $(20, 0)$ $(12, x)$

Find any two gradients and equate.

$$\frac{0-30}{20-10} = \frac{x-0}{12-20}$$

$$\frac{-30}{10} = \frac{x}{-8}$$

$$x = (-3)(-8)$$

$$x = 24$$

$$s = \frac{d}{t}$$

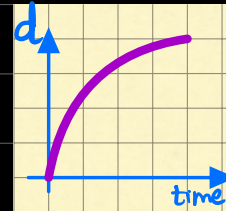
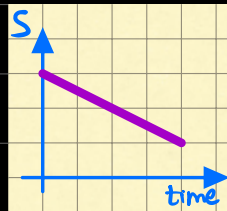
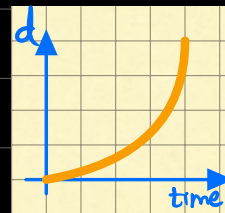
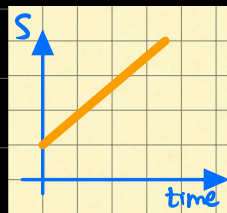
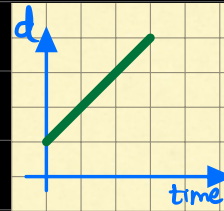
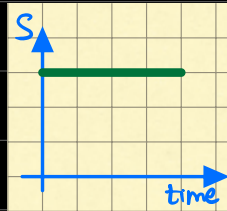
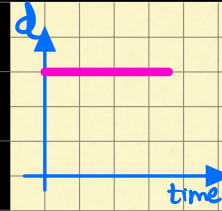
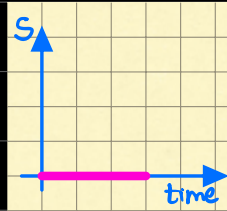
This formula is only correct
if speed is not changing.

Speed is constant.

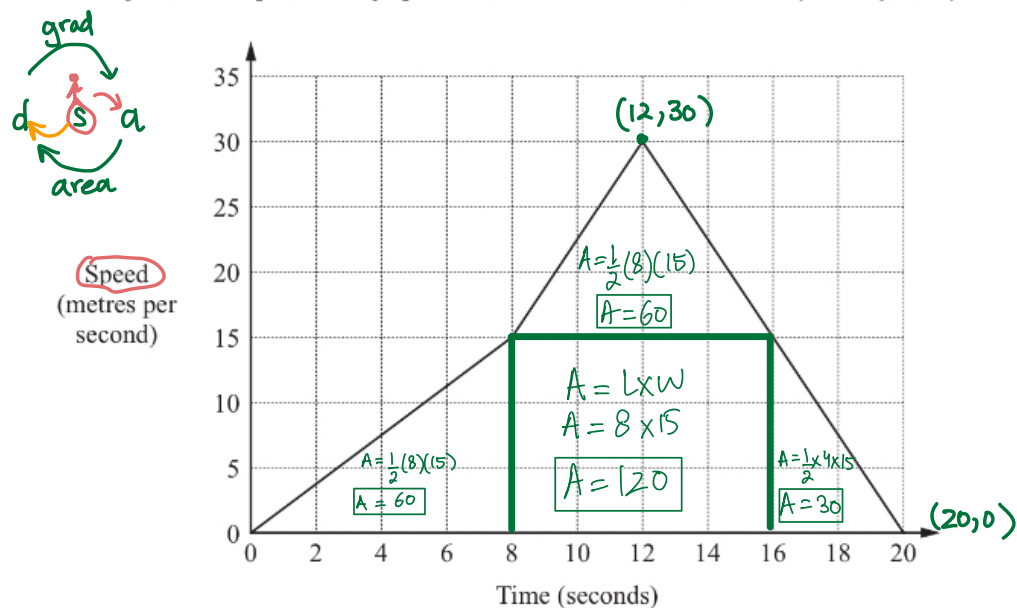
GRAPH CONVERSION

SPEED

DISTANCE



- 10 The diagram is the speed-time graph of the first 20 seconds of a motorcyclist's journey.



- (a) Calculate the motorcyclist's ^{acc (grad)}retardation during the final 8 seconds.

- (b) Calculate the ^{area under graph}distance travelled in the 20 seconds.
(12, 30) (20, 0)

(a) gradient = $\frac{0 - 30}{20 - 12} = -\frac{30}{8}$

acc = $-\frac{15}{4}$

Retardation = $\frac{15}{4}$

(b) Total Distance:

60
+ 120
+ 60
+ 30

270 m.

Answer (a) m/s² [1]

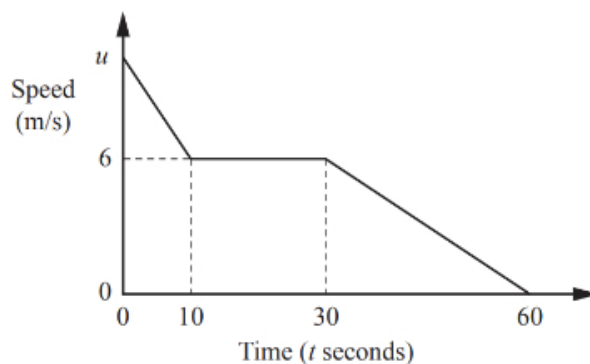
(b) m [2]

- 27 The diagram is the speed-time graph of part of a train's journey.

The train slows down uniformly from a speed of u m/s to a speed of 6 m/s in 10 seconds.

During the next 20 seconds it travels at a constant speed of 6 m/s.

It then slows down uniformly to a stop after a further 30 seconds.



- (a) Calculate the retardation from $t = 30$ to $t = 60$.

Answerm/s² [1]

- (b) Calculate the speed of the train when $t = 40$.

Answer m/s [1]

- (c) The distance travelled by the train from $t = 0$ to $t = 10$ is 85 m.

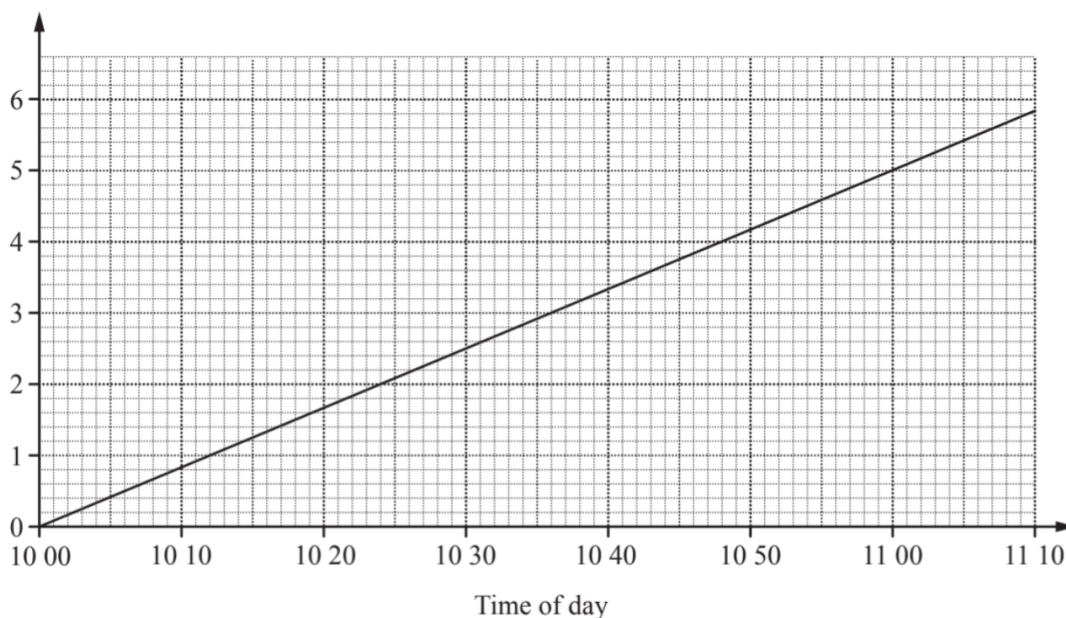
Find u .

Answer $u =$ [2]

- 12** A walker leaves his house at 10 00 and walks towards a shopping centre at a constant speed of 5 km/h.
 A cyclist leaves the same house 10 minutes later.
 He travels along the same road at a constant speed of 20 km/h until he reaches the shopping centre which is 6 km from the house.
 The cyclist stops at the shopping centre for 14 minutes.
 He then returns to the house along the same road at a constant speed of 20 km/h.

(a) The distance-time graph for the walker is drawn below.

On the same axes, draw the distance-time graph for the cyclist.



[3]

(b) Using the graphs, find

- (i)** the time when the cyclist, on his return journey, meets the walker,

Answer (b)(i) [1]

- (ii)** the distance from the house when this meeting takes place.

Answer (b)(ii) km [1]

